UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/569,548	02/27/2006	Kenzo Maehashi	12480000162US	7724

30593 7590 12/10/2009

HARNESS, DICKEY & PIERCE, P.L.C.
P.O. BOX 8910
RESTON, VA 20195

EXAMINER	
WONG, EDNA	

ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
12/10/2009	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/569,548	MAEHASHI ET AL.	
	Examiner	Art Unit	
	EDNA WONG	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 October 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) *7 and 8* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6 and 9-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *September 23, 2009*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

This is in response to the Amendment dated October 13, 2009. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office Action.

Response to Arguments

Election/Restrictions

This application contains claims **7 and 8** drawn to an invention nonelected without traverse in the reply filed on May 7, 2009. A complete reply to the final rejection must include cancellation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

Claim Rejections - 35 USC § 112

Claims **11 and 13** have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The rejection of claims 11 and 13 under 35 U.S.C. 112, second paragraph, has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 102/103

Claims **1-6 and 9-18** have been rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over **Bokova et al.** ("Laser-

Induced Effects in Raman Spectra of Single-Wall Carbon Nanotubes", *Quantum Electronics* (July 31, 2003), Vol. 33, No. 7, pp. 645-650).

The rejection of claims 1-6 and 9-18 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Bokova et al. has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 103

Claims **1-6 and 9-18** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Yudasaka et al.** ("Diameter-Selective Removal of Single-Wall Carbon Nanotubes Through Light-Assisted Oxidation", *Chemical Physics Letters* (June 4, 2003), Vol. 374, Issues 1-2, pp. 132-136) in view of **Howard et al.** (US Patent No. 7,396,520 B2) and **Bokova et al.** ("Laser-Induced Effects in Raman Spectra of Single-Wall Carbon Nanotubes", *Quantum Electronics* (July 31, 2003), Vol. 33, No. 7, pp. 645-650).

The rejection of claims 1-6 and 9-18 under 35 U.S.C. 103(a) as being unpatentable over Yudasaka et al. in view of Howard et al. and Bokova et al. has been withdrawn in view of Applicants' amendment.

Response to Amendment

Claim Objections

Claim **19** is objected to because of the following informalities:

Claim 19

line 2, it is suggested that the word “radiated” be amended to the word -- irradiated --. See claim 1, line 4.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

Claim **20** is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claim 20

lines 1-2, recite ”wherein the oxygen atmosphere is *air*”.

Applicants’ specification, pages 1-16, does not disclose wherein the oxygen atmosphere is air. Thus, there is insufficient written description to inform a skilled artisan that applicant was in possession of the claimed invention as a whole at the time the application was filed.

The Examiner has carefully considered the entire specification as originally filed, however, there is found no literal support in the specification for the newly added claim 20. Applicants have not provided the page number and line numbers from the

specification as to where the newly added limitations are coming from. *Ex parte Grasselli*, 231 USPQ 393 (Bd. App. 1983) *aff'd mem.* 738 F.2d 453 (Fed. Cir. 1984).

Claim Rejections - 35 USC § 103

Claims **1-6 and 9-20** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Yudasaka et al.** ("Diameter-Selective Removal of Single-Wall Carbon Nanotubes Through Light-Assisted Oxidation", *Chemical Physics Letters* (June 4, 2003), Vol. 374, Issues 1-2, pp. 132-136) in view of **Bokova et al.** ("Laser-Induced Effects in Raman Spectra of Single-Wall Carbon Nanotubes", *Quantum Electronics* (July 31, 2003), Vol. 33, No. 7, pp. 645-650), **Irle et al.** ("Theoretical Study of Structure and Raman Spectra for Models of Carbon Nanotubes in Their Pristine and Oxidized Forms", *J. Phys. Chem. A* (2002), Vol. 106, pp. 11973-11980), and **Howard et al.** (US Patent No. 7,396,520 B2).

Yudasaka teaches a structure control method comprising:

• irradiating a mixture of nano-scale low-dimensional quantum structures of differing densities of states (= HiPco SWNTs) with an electromagnetic wave (= a 488nm or 515 nm light) in an atmosphere, the electromagnetic wave having an energy density (= 0.3 mW/cm^2) [page133, left column, lines 11-22], so as to selectively oxidize a low-dimensional quantum structure of a density of states resonating with the electromagnetic wave (= these findings indicate that light irradiation may be a useful means of *selectively oxidizing* and removing SWNTs with certain diameters that

correspond to a gap energy close to the wavelength of the light used for the irradiation, and that SWNTs having semiconductor-type energy structures can be removed in this way) [page 135, right column, lines 32-38]; and

• measuring a second Raman spectrum of the irradiated mixture of nano-scale low-dimensional quantum structures (= we measured the weight, IR spectra, and Raman spectra of the dried HiPco SWNTs to confirm the light-assisted oxidation brought about diameter-selective elimination) [page 133, left column, lines 25-34].

The selective oxidation removes from the mixture the low-dimensional quantum structure of a density of states resonating with the electromagnetic wave (= these findings indicate that light irradiation may be a useful means of selectively oxidizing and *removing SWNTs* with certain diameters that correspond to a gap energy close to the wavelength of the light used for the irradiation, and that SWNTs having semiconductor-type energy structures can be removed in this way) [page 135, right column, lines 32-38].

The low-dimensional quantum structures comprise nanotubes or nanoparticles (= HiPco SWNTs) [pages 132-133, “2. Experimental”].

The low-dimensional quantum structures comprise carbon or boron nitride (= HiPco SWNTs) [pages 132-133, “2. Experimental”].

The low-dimensional quantum structures have a single-walled structure (= HiPco SWNTs) [pages 132-133, “2. Experimental”].

The nanotubes or nanoparticles comprise carbon or boron nitride (= HiPco

SWNTs) [pages 132-133, "2. Experimental"].

The nanotubes or nanoparticles have a single-walled structure (= HiPco SWNTs) [pages 132-133, "2. Experimental"].

The method of Yudasaka differs from the instant invention because Yudasaka does not disclose the following:

a. Measuring a first Raman spectrum of a mixture of nano-scale low-dimensional quantum structures of differing densities of states, as recited in claim ***1***.

b. Measuring a reduction in peak intensity of the second Raman spectrum to confirm the selective oxidation of the low-dimensional quantum structure, as recited in claim ***1***.

Yudasaka teaches measuring the weight, IR spectra, and Raman spectra of the dried HiPco SWNTs to confirm the light-assisted oxidation brought about diameter-selective elimination (page 133, left column, lines 25-34).

Like Yudasaka, ***Bokova*** teaches HiPco SWNTs. Bokova teaches that:

Depending on the geometry, nanotubes can be either semiconductors or metals. This property is crucial for the development of nanoelectronic elements and devices such as diodes, transistors, and logical circuits. The geometrical parameters of nanotubes should be strictly controlled in manufacturing such elements. However, up to now, there have been no methods for synthesis of monodisperse nanotubes with a specified diameter. *The homogeneity of a material can be substantially improved by performing its structuring using, for example, laser radiation*. Laser radiation can be simultaneously used to modify the material and excite its Raman spectrum, which characterizes this modification. *It is known that Raman spectra give information on the diameter and chirality of individual nanotubes, the type of their conductivity and the size of their bundles, the distribution of nanotubes over their diameters in a particular sample, and the purity of the material* (pages 645-646, "1. Introduction").

Like Yudasaka, ***Irle*** teaches carbon nanotubes in their pristine and oxidized forms. Irle teaches that *upon oxidation calculated Raman spectra show large reduction in peak intensities*, which can be attributed to the loss of cylindrical symmetry due to structural deformation. The study provides a novel explanation that Raman spectra of individual CNT's are highly sensitive to oxidation (page 11973, abstract).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method described by Yudasaka by measuring a first Raman spectrum of a mixture of nano-scale low-dimensional quantum structures of differing densities of states; and measuring a reduction in peak intensity of the second Raman spectrum to confirm the selective oxidation of the low-dimensional quantum structure because this would have gained insight into the changes in geometries upon oxidation of the nanotubes as taught by Bokova (page 645-646, "1. Introduction") and Irle (pages 11979-11980, "V. Summary and Perspective").

c. Wherein the atmosphere is *an oxygen atmosphere*, as recited in claim ***1***.

d. Wherein the oxygen atmosphere is *air*, as recited in claim ***20***.

Yudasaka teaches a H_2O_2 solution (page 133, left column, lines 18-28).

Howard teaches:

"Oxidant" as it is used here refers to the oxidizing agent fed to the combustor. Once in the combustor the oxidant can be assumed either to participate directly, i.e., as a reactant, in oxidation reactions or it may be converted to other oxidizing species which in turn participate as reactants in oxidation reactions. The most preferred oxidant in fullerenes synthesis by combustion is *molecular oxygen or O_2, which may be fed* as pure O_2, *as air*, as O_2 mixed with one or more inert gases, as O_2-enriched air, as air

partially depleted of its original nitrogen, or in other mixtures. The O_2 may serve as the oxidizing reactant in the combustor or it may be converted to some extent to OH, O, HO_2 , H_2O, CO_2, or other oxygen-containing species *which in turn serve as reactants in oxidation reactions*. Other oxidants of some interest under certain conditions as feeds for a fullerenes synthesis combustor are *hydrogen peroxide (H_2O_2)*, ozone (O_2), and mixtures of these with an inert gas and/or one or more of the species OH, O, HO_2, H_2O, CO_2, or other oxygen-containing radicals or stable molecules (col. 6, line 56 to col. 7, line 7).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the atmosphere described by Yudasaka with wherein the atmosphere is an oxygen atmosphere; and wherein the oxygen atmosphere is air because air would have been functionally equivalent as an oxidant in the treatment of nanomaterials as taught by Howard (col. 6, line 56 to col. 7, line 7).

Furthermore, it has been held that the selection of a known material based on its suitability for its intended use supports a *prima facie* obviousness determination (MPEP § 2144.06 and § 2144.07).

Furthermore, Bokova teaches air (page 646. “2. Experimental”).

e. Wherein the energy density is 10 kW/cm^2, as recited in claim ***1***.

Bokova teaches that *the selective resonance response of nanotubes can be tuned* not only by scanning the laser excitation frequency but also by varying the laser power density (the laser wavelength being fixed). The spectra were recorded at different 514.5 nm excitation power densities. In the first spectrum *excited at a power density of 10 kW cm^{-2}*, the 187 cm^{-1} breathing mode dominates, which corresponds to nanotubes of diameter 1.32 nm (page 648, “3.2 Reversible changes in Raman spectra of single-

wall carbon nanotubes caused by laser radiation"; and Fig. 6).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the energy density described by Yudasaka with wherein the energy density is 10 kW/cm^2 because the energy density is a result-effective variable and one having ordinary skill in the art has the skill to calculate the energy density that would have determined the success of the desired reaction to occur, e.g., where the 187 cm^{-1} breathing mode dominates, which corresponds to nanotubes of diameter 1.32 nm (MPEP § 2141.03 and § 2144.05(II)(B)).

f. Wherein the electromagnetic wave is a laser beam, as recited in claims ***6 and 15-18***.

Yudasaka teaches that while being mixed with the H_2O_2 solution, the SWNTs were irradiated by a 488 nm light (0.3 mW/cm^2) or 515 nm (0.3 mW/cm^2) [page 133, left column, lines 18-28].

Bokova teaches radiation from *a cw argon laser* at 488.0 nm (2.54 eV), 495 nm (2.50 eV), and 514.5 nm (2.41 eV) [page 646, "2. Experimental"].

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the electromagnetic wave described by Yudasaka with wherein the electromagnetic wave is a laser beam because a cw argon laser would have radiated a 488.0 nm (2.54 eV) or 514.5 nm (2.41 eV) light as taught by Bokova (page 646, "2. Experimental").

g. Wherein the mixture of nano-scale low-dimensional quantum structures is radiated for two hours, as recited in claim ***19***.

Yudasaka teaches 30 minutes (page 133, Fig. 1).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the mixture described by Yudasaka with wherein the mixture of nano-scale low-dimensional quantum structures is radiated for two hours because the radiation time is a result-effective variable and one having ordinary skill in the art has the skill to calculate the radiation time that would have determined the success of the desired reaction to occur, i.e., the oxidation and removal of SWNTs (MPEP § 2141.03 and § 2144.05(II)(B)).

Furthermore, changes in the radiation time is not a patentable modification; however, such changes may impart patentability to a process if the ranges claimed produce new and unexpected results which are different in kind and not merely in degree from results of the prior art, such ranges are termed “critical” ranges and Applicant has the burden of proving such criticality; even though Applicant’s modification results in great improvement and utility over the prior art, it may still not be patentable if the modification was within capabilities of one skilled in the art; more particularly, where general conditions of the claim are disclosed in the prior art, it is not inventive to discover optimum or workable ranges by routine experimentation (MPEP § 2144.05).

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to EDNA WONG whose telephone number is (571) 272-1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for

published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Edna Wong/
Primary Examiner
Art Unit 1795

EW
December 3, 2009